Chapter 23
Lunchbox-Toolbox: GKS1350021 and Nuclear Engineers

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Abstract This is a personal essay, written from the viewpoint of an ordinary citizen to nuclear engineers, on the necessity of communicating vital information about radioactive contamination to the public during times of normalcy as well as times of crisis. I have no expert knowledge of nuclear energy, nor was I involved in the PAGES 2011 Summer School from which this book emerges. I was invited by the chief editor to contribute a chapter about communication from my point of view as a literary scholar, ESL instructor, and American living in Japan (since 1987). In this chapter, I advocate the creation of a "library" of essential knowledge of nuclear energy in general, and radioactive contamination in particular, to serve the needs of a non-expert public. This "library" would be online, constantly updated, robust, truthful, transparent, comprehensible to lay readers, and politically neutral. My appeal to nuclear engineers to undertake such a task is presented through six topics which allow me to address the social needs and concrete skills involved in knowing what, how, and why to communicate: (1) transparency and comprehensibility, (2) the Ex-SKF blog/ger, (3) meeting Joonhong Ahn, (4) teaching "Fukushima" in my literature course, (5) the concept and practice of a "scientist citizen" (referring to Cecile Pineda's *Devil's Tango* as one model), and (6) the reciprocal entity "citizen scientist."

Keywords Communication between nuclear experts and laypersons · Online nuclear science library · Lunchbox-toolbox · Scientist citizen · Citizen scientist · Ex-SKF · Joonhong Ahn

23.1 A Request: From GKS1350021 to Nuclear Engineers

This chapter is about communication between nuclear experts and the public in the wake of the accident at Fukushima Daiichi NPP that began on March 11, 2011.

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J. Ahn et al. (eds.), *Reflections on the Fukushima Daiichi Nuclear Accident*,
DOI 10.1007/978-3-319-12090-4_23

As GKS1350021—the alphabets are my initials; the number is my zip code in Tokyo—I write in the spirit of an open letter to present and future nuclear engineers around the world. I am not a nuclear engineer or social scientist involved in the project reported on and responded to through this book. I have no special expertise regarding any aspect of nuclear energy. I am a literature scholar born and raised in Hawai'i, and citizen GKS1350021. The potential value of what I have to say regarding issues addressed in this volume derives solely from personal values shaped through many years of studying and teaching literature, social relationships acquired in the communities that raised me, and what I have experienced as an American citizen residing in Japan since 1987. But I call attention to these facts because paying attention to someone's specifically sited existence underpins successful communication in any situation, all the more so in times of crisis.

In the case of Fukushima Daiichi NPP as it was handled by the Japanese government and TEPCO, communication grounded in a sense of accountability to specific individuals was profoundly lacking. Citizens like GKS1350021 suddenly needed hard facts about nuclear power plants and wanted their information from experts, not politicians or industry insiders, yet we looked to Government and TEPCO to facilitate getting that information to us. We sought this information from our standpoints as individual human beings; our concerns as consumers of electricity, owners of TEPCO stock, or supporters of this or that political party were also real, but secondary in those first days and weeks. On March 11, our first thoughts turned automatically to ascertaining the safety of family, relatives, neighbors, and friends. As images of survivors throughout the Tohoku region materialized on television and computer screens, we struggled to grasp and respond to their need for shelter, water, food, and medical care. But within days our energies were taken over—if our homes had escaped damage, if we had not lost electricity, if we were not caught up in the confusion of evacuation zones—by the shock of water and food contamination fanning out from Fukushima Daiichi NPP. Panic, dread, anger, and depression set in, fueled by a shortage of reliable information, by Government and industry leaders who refused to tell us clearly and precisely what was really happening, or at the very least, whatever they themselves knew.

Citizens like GKS1350021 expected the Prime Minister and his staff, if not TEPCO management, to facilitate dissemination of information from nuclear experts as to what exactly was happening at Fukushima Daiichi NPP, and to transmit information from specialists in radiology, medicine, and nuclear physics as to what the nuclear meltdowns meant in terms of short- and long-term environmental contamination and how that contamination translated into specific dangers to water, food, and the human body. But however much citizens like GKS1350021 looked to their political and industry leaders to receive such information in a timely, continuous, and accessible manner, we waited in vain. As days turned to weeks and months, alongside images of earthquake-tsunami survivors searching for family members and adjusting to life in shelters or stranded communities, alongside surreal scenes from a nuclear power plant in tatters, we were also forced to witness the political jousting in Nagata-chō as the LDP, DPJ and other parties devoted themselves to exploiting the nuclear accident to regain or retain political

power. Radioactive contamination filled me with dread; the landscape of ruin along the coasts of Iwate, Miyagi, and Fukushima filled me with despair. But the sickening spectacle in Nagata-chō filled me with rage.

In a crisis, governments justify censorship with the need to "maintain order" and "prevent panic." I remember thinking then (in March, April, May, June, July 2011), and still believe now, that if instead of communication aimed at pacifying the population and evading accountability, we had been told the stark truth of what was probably/happening, to the extent that it was known or could be reasonably inferred, such communication would have done far more good than harm.

Let us say that one day, I am told in no uncertain terms that my vital organs have suffered a meltdown and I have 6 months left on this earth. I think I would want to know precisely what to expect as things deteriorate, so that I could decide how best to live those 6 months. Although it's possible that I might panic or fall into debilitating depression when I get the information I demand, it's equally imaginable that, motivated by a heightened appreciation of my own life and a sense of responsibility to others, I would neither panic nor plunge into despair, but work productively to put my affairs in order for the benefit of those who will survive me.

I know, of course, that this is not a perfect analogy for arguing the probable or possible impact on, say, the 13.5 million residents of Tokyo if they had been told immediately and straightly that there were three meltdowns and exactly where the toxic plumes had gone and which cancer-inducing elements were in them. No one can say for sure what percentage of Tokyo's 13.5 million would have tried to flee Tokyo (beyond whatever number who actually did in March 2011) in response to a hypothetical government strategy of 100 % truth-telling. No one can say with certainty what new crises would have been triggered by such an exodus as it clogged transportation routes and consumed all available shelters and food supplies, which were already disappearing due to hoarding. Even if only 1 % fled the metropolis, could 135,000 people so easily find a new place to live, and for how long if they left their former workplaces? If 10 % of Tokyo fled, that's 1,350,000 people looking for a place to live and work. So let me acknowledge again that I have no "scientific" basis for imagining responses other than mass panic and chaos if government and TEPCO had chosen the path of relentlessly truthful communications regarding the hourly and daily condition of Fukushima Daiichi NPP.

Nonetheless, a very different scenario remains a possibility, and therefore deserves as much consideration as the more automatically envisioned scene of mass panic. In other words, it is possible that large swaths of the Japanese citizenry would have responded to accurate, comprehensive, straightforward information about the nuclear accident in the way I like to imagine I would respond to a diagnosis of impending death with 6 months left to live. Large swaths of the Japanese citizenry, *in response to witnessing the ethical courage of their government and industry leaders* in stating the facts about the meltdowns and their probable consequences, and thereby demonstrating genuine concern for the effect of the nuclear accident *on the individual lives* comprising the body politic, would be moved, reciprocally, to pool and coordinate their individual specialized

knowledge—as farmers, doctors, chemists, geologists, physicists, psychologists, therapists, caregivers, bankers, teachers, cooks, emergency aid workers, artists, trauma victims, NGO administrators, mothers, and carpenters, to name just a few domains of expertise. They would be joined by thousands more across Japan, ordinary citizens like GKS1350021 without any particular expertise but able to furnish physical labor and time to help deliver the organization of specialized knowledge to specific groups of people in specific places whose situation would then be alleviated immediately upon receiving such help. In other words, I imagine that a different concept and practice of communication would have created a scenario quite different from what actually happened in the wake of 3/11. We might have witnessed a breathtaking, nationwide, coordinated emergence of individual human resources via a grassroots crisis management movement. In other words, a people's crisis management made possible and brought into being through a vastly different kind of communication from Government and nuclear industry leaders: unrelenting truthfulness via transparency and comprehensibility.

23.2 Invisibility Versus Transparency: The Ex-SKF Blog

If the radioactive contaminants released from the crippled reactors were terrifying because of their invisibility, communications from Government and the nuclear industry induced profound anxiety for precisely the opposite reason—because they lacked transparency.

For GKS1350021 in the immediate and prolonged aftermath of the nuclear accident, negotiating everyday life choices in order to minimize radioactive contamination always came down to the issue of "communication," defined here as the goal/s, content/s, and method/s of every act of sending and receiving information, and the aggregation of such individual acts. Every act of communication is a decision originating in the minds of one or more specific individuals, about why and how to communicate what, whether in the course of routine work or times of crisis.

Indeed, my personal belief is that we can only exercise in times of crisis the forms and goals of communication we have practiced or attempted to devise during the course of our routine work. There is a lot of talk these days about "thinking outside the box," but in fact such thinking cannot be expected from most of us if we have never been encouraged to understand or perform "thinking outside the box" as a viable form of response in ordinary life. Nor can we suddenly care about "society" as individuals if we are not used to conceptualizing Japan's 127 million residents as individuals. In 2011 and since then, Government's concept of "the people," by and large, has been "a faceless entity to be pacified, deceived, and

ignored."[1] Their concept of "responsibility to the citizenry," judging by their actions and more tellingly their non-actions, has meant protecting the political life of politicians, or doing whatever was necessary to enable the nuclear industry to carry on business as usual. On NHK and other TV stations, although there was nonstop "coverage" of the nuclear accident in the first weeks after March 11, I cannot recall seeing any instance of Japanese nuclear experts organizing themselves as an independent professional community to address the public in comprehensible language about what they were observing or surmising was happening at Fukushima Daiichi NPP, or what they understood to be the consequences for the human body of what they were seeing as it unfolded each day.

What does transparency look like when communication is dedicated to converting the invisibility of radioactive contamination, and the invisibility of political and industrial practices, into tangible, graspable knowledge in the service of public discussion and decision-making regarding nuclear energy?

By September 2011, I had discovered the Ex-SKF blogger.[2] To be precise, I requested an email subscription to Ex-SKF on September 16, 2011, and that is when I started to read this blog each time a new post arrived in my smartphone email box. This was the first watershed in the relationship between GKS1350021 and Fukushima Daiichi NPP. In the half year from March 11 to September 11, I had become extremely worn out with the effort to search for, sift, grasp, assess, and correlate information on the situation in Fukushima as well as my residential neighborhood in Tokyo's Koto Ward. I live about 6 km north of Tokyo Bay, where radioactive ash has been deposited as landfill, and about 4 km west of the Arakawa River, where an incinerator for regular household garbage burns debris trucked in from Tohoku. These policies were part of the unfathomable thinking of Government that spreading the toxic debris throughout Japan constituted an act of patriotism, democracy, and solidarity with those who had borne the brunt of loss and injury from the triple

[1] When I wrote these sentences, it had been almost 48 h since a man set himself on fire near Shinjuku station, Tokyo (29 June 2014) to protest PM Shinzō Abe's determination, despite widespread opposition from the public, to enable Japan's Self-Defense Forces to engage in combat overseas by simply changing a longstanding interpretation of war-renouncing Article 9 of the constitution. The day after the attempted self-immolation, Abe's "re-reading" became a fait accompli when it was passed by his cabinet. Abe's Chief Cabinet Secretary Yoshihide Suga's response to the incident captures the irony of political leaders proclaiming sincere efforts to protect the country's citizens while dismissing the importance of their individual identities or the injury done to their individual bodies. Suga declared, "The government should protect people's lives and property as well as the country's safety," but as for the self-immolation, he brushed it aside by saying that while he was "aware of the incident" he was "not in a position to comment on an individual case" [1].

[2] The first post about the triple disaster reports that the blogger was able to make phone contact with family in Tokyo soon after the earthquake struck at 2:46 pm on 11 March 2011 [2].

disaster. In the first 6 months after March 11, there were many things I felt I needed to know but couldn't find answers to, because in the limited time I could devote to internet searches the information I sought in English was not easily discoverable on the web, or because the information I was able to access spoke of radiation in general terms or for sites other than Fukushima, and thus was not easily applied by a layperson like me to the produce making its way into my local supermarket, let alone all the foodstuffs I was ingesting whenever I had lunch or dinner near my workplace.

At my local supermarket, it was now taking me one hour to get through what used to be a 10 min trip, because now I was trying to read every label completely to figure out exactly where every item of food came from. But at the same time I couldn't help thinking: surely the labels are not 100 % trustworthy. No one who has read Eric Schlosser's *Fast Food Nation: The Dark Side of the All-American Meal* (2001) can ever fully trust food labels again. And what exactly does screening for radiation levels consist of or mean, since presumably not every single bean or carrot can be tested? Meanwhile, husband (an experimental psychologist) and son (a college student majoring in business) were weary and aggravated by my constant nagging at them: to not get wet in the radioactive rain, to avoid going too close to street drains and trees and shrubbery because cesium concentrations would be highest there, to not (for the same reason) enjoy wading through the fallen leaves that autumn of 2011; my list of Avoid This and Don't Eat That was long. Meanwhile, I couldn't very well launder every item of clothing as soon as someone stepped into the house, or have all of us shower down as soon as we got home, and what about our shoes and coats and bags (filled with personal belongings neither washable nor replaceable every day) and non-food purchases that had passed through so many unknown locations before we picked them out and brought them home? I split into two people: the woman who nagged to keep from screaming, and the woman who watched the nagger and understood that she needed to figure out a better strategy for living in the post-Fukushima Daiichi world. It was in this state of mental and physical fatigue that I found Ex-SKF, and my heart leaped up when I beheld the original website featuring a fearless yet comical Ultraman as its mascot. The humor was bracing, the bilingual information a lifeline.

The Ex-SKF blogger does paste-ins of Japanese-language articles, often in their entirety, and provides links to the original sites of these articles along with translations into English, rendered in near native fluency. Besides textual information, this blog's archive includes videos, photographs, data in graph or chart form, and coverage from English-language newspapers and websites around the globe. (There is also a Japanese-language version of the blog.) In sum, the English version of the Ex-SKF blog is a bilingual database with extensive coverage, and these two features have several important consequences.

First, readers who are fluent enough in both Japanese and English are enabled and practically invited to crosscheck the blogger's rendering of Japanese-language information into English. Second, English-dependent readers like GKS1350021 gain access to a huge amount of information not available anywhere else, and impossible to locate on a daily basis short of devoting oneself, like the blogger, to such a project. Third, transparency is a guiding principle for re/presentation of information: Links to

original sources as well as other relevant material are provided, and when necessary, tips on how to access and read the information at these sites are also given, based on the blogger's own prior experience in navigating those sites. Transparency means that little or no energy need be wasted on wondering how reliable or partisan the presentation of the information might be. I myself have never bothered to do a cross-check, not because I trust this blog completely but because I've always known that I can check up on things whenever I want to. The archival trail followed by the blogger is clearly marked for others to follow. This blog is not motivated by a desire to get the journalistic scoop, although it does take (justifiable) pride in pointing out when it first took notice of something that others did not begin to discuss widely until much later. Such transparency in reporting creates a deep sense of reliability and trust. I read this blog because it is dedicated to delivering accurate, comprehensive, constantly updated, comprehensible information to readers, all of which becomes instantly accessible for future reference in the blog's archive.

In addition to culling articles on the same topic from different media sources, and in addition to a continuous flow of English translations of Japanese-language sources of information, Ex-SKF also provides personal analysis of the information culled. When the blogger offers opinions or speculations, they are clearly presented as such. The line is always clearly marked between what constitutes the blogger's commentary or analysis and what constitutes the information gathered and re-presented from a variety of media.

Finally, the Ex-SKF blog contextualizes the nuclear accident within global politics and economics. Events from around the globe are not ignored just because they are intrinsically unrelated to things nuclear. Quite the contrary: posting news about the Arab Spring, Obama's reelection, or Tokyo's winning bid to host the 2020 Summer Olympics in a blog called "Covering Fukushima I (Daiichi) Nuclear Accident since March 11, 2011" [3], with the accompanying November 2013 photo of the spent fuel pool in Reactor 4 (which eventually replaced Ultraman as the blog's mascot), makes the point that a nuclear accident cannot be understood in isolation from the flow of global history. Further, this flow of "external" news includes, from time to time, events that will never be news anywhere except on this blog—things like the Ex-SKF blogger's personal selection of music to celebrate Christmas or a birthday. Such apparently "unnecessary" contextualization of information about Fukushima Daiichi NPP is also part and parcel of Ex-SKF's policy of transparency. We are asked to take notice of this blogger's existence as an individual, although we are always aware of it in the personal voice that infuses the blog while not compromising its commitment to transparency. In the Ex-SKF blog, we receive our information from one individual human being, not a disembodied voice that covers over the speaker's stakes in the matters being spoken of.

Over the past 18 months, Ex-SKF's rate of posting new material has declined noticeably.[3] Perhaps personal circumstances might be partly responsible

[3] Archive information at the blog site indicates more than 1,300 posts between 13 March 2011 and 1 January 2012; 1,160 posts in 2012; 601 posts in 2013; and 127 posts in 2014 up through July 28 [3].

(on January 26, 2014, Ex-SKF mentions being in bed for a week with the flu), but I think the decrease is largely the result of less and less information generated about Fukushima Daiichi NPP 3 years and 4 months after the start of the accident. A certain stability has been achieved, even despite the fact that (a) on-site contamination is still extremely high and far from being fully ascertained or mapped, (b) a number of dire problems remain unresolved even if they are no longer regularly reported on in mainstream media (e.g. where to put the continuously generated radioactive water that cools the broken reactors; likewise where and how to dispose of contaminated dirt, leaves, and other debris that have been collected throughout Tohoku and presumably will continue to be gathered up for disposal at future dates), and (c) we have no idea how much knowledge about the nuclear meltdowns was and still is being withheld from us by Government, TEPCO,[4] the nuclear industry, or the media. To repeat: despite the immensity of the unknowns alluded to in (a), (b), and (c), a certain stability seems to have been achieved at Fukushima Daiichi NPP, which would explain the sharp decrease in postings by Ex-SKF. But this is not to suggest that Ex-SKF has become obsolete as a source of information or that its value has peaked. No, precisely because the current stability at Fukushima Daiichi NPP (or any other nuclear power plant anywhere in Japan) is quite fragile given the uncontrollable probability of a large earthquake occurring too close, and precisely because of Government's unconscionable disregard of (a), (b), and (c) in its push to restart idled reactors and keep Japan dependent on nuclear energy without allowing the public a say in decision-making, the Ex-SKF blog remains indispensable as a bilingual, open-access, comprehensive, unfolding-in-real-time archive of events at Fukushima Daiichi NPP, that prioritizes transparency.

For all these reasons, then, the Ex-SKF blog models what I think ought to be the key elements of an online "library" of information on Fukushima Daiichi NPP set up and run by nuclear engineers, who would also be dedicated to truthfulness, political neutrality, and transparency, and not averse to adding the occasional touch of Christmas music or other expressions of the human being of the library's creators and operators. I envision this "library" as a necessary point of reference for both pro-nuclear and anti-nuclear groups, such that both groups can be enabled to see what they currently do not see, admit, or accept.

[4] A recent example of not being told what happened when it happened is TEPCO's belated announcement on 23 July 2014 that on 19 August 2013, more than 1 trillion becquerels of radioactive substances were released over the course of four hours during a cleanup procedure at the No. 3 reactor of Fukushima Daiichi NPP [4]. As early as March 2014, the Ministry of Agriculture informed TEPCO that its decontamination work on 19 August 2013 had contaminated rice harvested from Minami-Soma during the same month, but the Ministry did not inform the people of Minami-Soma about the contamination [5].

23.3 Lunchbox-Toolbox: Meeting Joonhong Ahn

If discovering the Ex-SKF blog was the first watershed for GKS1350021 in the wake of 3/11, the second watershed was meeting Joonhong Ahn at a 2-day symposium—Fukushima: Lessons Learned?—convened at Oberlin College on 9–10 March 2012, to assess the wake of the nuclear disaster on its one-year anniversary.[5]

Besides Joonhong, who presented a paper entitled "Fukushima from Environmental Remediation, Waste Management, and Back-end of Nuclear Fuel Cycle," other panelists included Kennette Benedict, executive director of The Bulletin of the Atomic Scientists, Akira Tashiro, executive director of the Hiroshima Peace Media Center, David Lochbaum, director of the Nuclear Safety Project for the Union of Concerned Scientists, and Allison MacFarlane, then associate professor of environmental science and policy at George Mason University, and since July 2012, chair of the U.S. Nuclear Regulatory Commission. But among all the panelists, it turned out that only Joonhong possessed detailed knowledge of the Japanese nuclear industry and actual work experience within Japan's "nuclear village" [7].

So during lunch break on day one of the conference, I grabbed a seat next to Joonhong. His presentation turned out to have been the most technical, and the least familiar to me (a literary critic) in terms of format and presentation style, but as a specialist in remediation (one of several technical terms I picked up that day), I judged that he had the technical knowledge to answer my most pressing questions about radioactive contamination and the internal structure of the nuclear industry.

I no longer remember everything I asked him nor how exactly I phrased my questions, but I cannot forget one thing he said that became the most important piece of information I took away from the conference: that even if all parties agree to switch immediately and completely to renewable energy, the nuclear power plants cannot simply be shut down. It is not a matter of simply turning off a switch or dismantling the reactor buildings. The plants would need expert tending for a very long time, and it was of paramount importance to maintain a fleet of nuclear engineers capable of doing first-rate maintenance work on decommissioned reactors.

Thus I was made to understand, over lunch, the naiveté of an anti-nuclear activism that calls for "shut down" without any idea of the actual procedures and time

[5] Oberlin professor Sylvia Watanabe (Creative Writing) came up with the idea for the symposium, and it was co-organized with two other Oberlin faculty, Nanette Yannuzzi (studio art) and Ann Sherif (East Asian studies). In addition to main sponsor Oberlin Shansi, many departments and offices at Oberlin College lent their support to this event [6]. I had been corresponding with Sylvia since 2008 regarding mutual research interests that included atomic history, and so I knew about the symposium in advance. I went because I needed to hear, in a language I could understand fully, expert assessment of what had happened and where we now stood, and I was able to attend because the conference fell during spring break at my university.

frame involved in decommissioning a reactor even after it can be agreed upon to do so. How the absence of active nuclear power plants makes it difficult to train the next generations of nuclear engineers who must carry out the long-term work of shutdown. At this point I made the connection to what I had learned recently about the "gerontology" of aging nuclear weapons at Los Alamos National Laboratory, including the problem of how to equip new generations of nuclear weapons scientists with the knowledge they need to care for increasingly fragile, volatile bombs if they do not have "active" sites of nuclear weapons production to learn and maintain their expert knowledge [8].

Lunchbox-Toolbox is my shorthand expression for insisting that a nuclear engineer's work must not be conceptualized and undertaken apart from the everyday lives of citizens. The mission of technology and science—the toolbox—is to serve the daily well being of citizens—the lunchbox. It is fairly easy to observe when this mission is being upheld and when it has been abandoned by noticing which one retains priority. If the lunchbox is sacrificed, it can only mean that the toolbox is perceived as accountable to no one but itself.

The literary critic Elaine Scarry has pointed out that a tool can be a weapon depending on whether it falls on a sentient or nonsentient surface.[6] An axe is a tool when the human hand is on the handle and the blade is toward a tree, but an axe is a weapon when the blade is directed towards human flesh. Actually any object, not just tools but things like chairs or bottles of wine, can also become weapons. It all depends, observes Scarry, on whether an object is being used to alleviate or inflict pain.[7] A chair is originally created to alleviate pain, to provide comfort; likewise a bottle of wine, or the axe that fells a tree for firewood to warm a home in winter. But each of these objects can become weapons when the intended or predictable result of their deployment is the infliction of pain: if the chair is thrown at someone, if the bottle of wine is poisoned, if the ax strikes down a tree simply to kill or maim it.

Lunchboxes, too, can inflict pain. Japanese schoolchildren were fed contaminated beef,[8] and TEPCO stopped providing free boxed lunches ("obentō") for the workers decontaminating Fukushima Daiichi NPP. The beef that young schoolchildren in Yokohama were made to eat could and should have been screened by people who knew how to do it properly, since by the start of the school year in April 2011 it would have been impossible for anyone genuinely concerned about children's safety to dismiss widespread fears of extensive radioactive contamination as "baseless rumors" rather than trying to ascertain, through trustworthy testing by trustworthy agents, whether the ingredients of school lunches were

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[6] Scarry [9], 173.

[7] Scarry [9], 144–150.

[8] 67,000 children were fed tainted beef between April and July 2011 [10]. Yokohama schools undermined the well being of children in other ways [11]. Fukushima cattle, contaminated from being fed contaminated rice straw, got past government inspections or the farmers had not received instructions to stop feeding them rice straw; meat from these cattle was shipped to various parts of Japan [12]. Free lunches were stopped for Fukushima workers [13].

contaminated or not. After all, the fact that children face elevated risks of developing cancers compared to adults was already common knowledge prior to the nuclear accident. As for the termination of free lunches for decontamination workers at Fukushima Daiichi NPP, that cost could and should have been borne as a sacrifice to someone else—if not the ratepayers whose household electricity bills went up 15 % since March 11, 2011, and who, for decades in fact, had already absorbed the cost of paying $25,000,000 worth of bribes to seven Prime Ministers as part of regular business practice,[9] then surely the top echelon of TEPCO management, or former and present prime ministers, could take the hit to their own pockets to feed the front line of workers at Fukushima Daiichi NPP.

There were, however, many individuals with expert knowledge in nuclear contamination who did step forward with their toolboxes, or were sought out by concerned citizens who did not themselves have the necessary expertise, and these various individuals each labored to maintain the mission of technology/science to promote the well being of citizens. Though their individual names and contributions remain relatively unknown, their work demonstrates the power of the 99 % to change things no matter how inept or callous Government and TEPCO continue to be, or no matter how unfathomably inactive nuclear experts in Japan—as a collective—remain.

One example that I can speak of with firsthand knowledge, because I attended his lecture at Temple University Japan on 3 July 2012 [15] and soon after had the privilege of interviewing him for more than two hours on 12 October 2012, is nuclear physicist Ryūgo Hayano, who was instrumental in organizing early on a systematic, broad-based program to test school lunches in Fukushima for cesium contamination.[10] His results from screening school lunches in Fukushima put many people at ease, illustrating how crucial it is to get experts on site as quickly as possible, who are capable of gathering and analyzing information properly. Swift and skilled intervention from experts enables the various problems arising from a crisis to be prioritized, and the most appropriate concrete responses applied.

But as we continue to seek out and look to the Ryūgo Hayanos of Japan for guidance and models of social responsibility from nuclear experts, let us always remember that lunchboxes and toolboxes are only as good as the hands that make

[9] A former top official at Kansai Electric Power Co. has come forward to reveal a nearly 20-year history of doling out ‘top secret’ huge donations to Japanese prime ministers, funded on the backs of ratepayers. Chimori Naito, 91, a former KEPCO vice president, said that for 18 years from 1972, seven prime ministers received 20 million yen (about $200,000 now) annually from Yoshishige Ashihara, who served as both KEPCO president and chairman” [14].

[10] Hayano gave a PPT talk at CERN (The European Organization for Nuclear Research in Switzerland) on 4 April 2013 explaining his work in and for Fukushima: measuring cesium contamination in school lunches, assisting several hospitals with the proper use of whole-body counters, and figuring out a system for calculating radioactive iodine contamination in order to provide a basis for future government subsidizing of medical expenses for Fukushima residents who develop thyroid cancer [16].

or use them, at each step of the way. Every single time a lunch is eaten or a tool deployed, an individual conscience has guided—or not—the action of the hands that assembled the lunch or wielded the tool.

The importance of speaking out about this crucial relationship between hands and toolbox took shape in my mind after I'd spent many weeks reflecting on the impact of my lunchtime conversation with Joonhong. Eventually I realized that I had received a significant piece of information from him not simply because he was an expert who could tell me such things, but because the telling was guided by personal values and communication skills that virtually guaranteed the transmission of his knowledge to me, and my thoughtful reception of it in turn. I had gone to that conference carrying a year's worth of anger, fear, and depression, and so I'm pretty certain that I came across aggressively and convinced of my moral rightness when I asked Joonhong how anyone in the nuclear industry could justify continuing to work for it in the wake of the nuclear accident at Fukushima. The way he chose to respond says a lot about the indispensability of communication skills for nuclear engineers, and what those skills consist of.

First off, there was the courteous demeanor without a trace of condescension but plenty of patience. He received my vehement criticisms of various individuals or groups of individuals with a smile while remaining diplomatically neutral; this had the therapeutic effect of letting me vent frustration while politely implying that it was not the most enlightened way to discuss exiting nuclear energy. Second, his technical expertise was informed by a personal take on the social politics of nuclear energy, for example his observation during the final roundtable at the conference that every nation has the right and responsibility to decide whether they want to be nuclear or non-nuclear. Third, his patient, low-key manner suggests a generous pragmatism when dealing with entrenched systemic flaws or difficult individuals, which I surmise underlies his ability not only to have let a perfect stranger monopolize his lunch break and spend half of it venting, but to have worked so long within Japan's nuclear village amongst colleagues or established ways of thinking he may not particularly like or respect.

That Joonhong would invite a literary critic to contribute a chapter to this book speaks volumes about his commitment to lunchboxes. For many weeks after the end of the conference, I kept trying to pin down exactly what it was that continued to linger in my mind, over and beyond that crucial piece of knowledge I had been given regarding the reality of decommissioning nuclear reactors. Eventually I realized that it was the felt experience of the conversation itself, my direct experience of Joonhong's way of communicating his expertise to me, that had transmitted what lingered in my mind long after the conference ended—my strong sense of his reliability and genuine concern for fellow citizens, and the hope this inspired in me. Writing about this episode now, I am struck by the indispensability of our most "primitive" and increasingly rare form of communication in this age of social networking—the face-to-face dialogue between strangers (to be distinguished also from chatting or light conversation). But let me take these thoughts one step further. Even if communication skills are, finally, what enable transmission of expert knowledge to a layperson, and even if various "communication skills"

can be identified, practiced, and learned in order to facilitate such transmission of expert knowledge, in regard to the lunchbox-toolbox relationship—the obligation of science and technology to serve the well being of citizens—successful communication means something more fundamental than this or that communication skill. It's about whether engineers *want* to place expert knowledge in the service of others, and whether they succeed in communicating *that* fact when they speak to laypersons.

23.4 Remediation and GKS1350021: Teaching Contamination as a Literary Critic

As I said earlier, I live only a few kilometers from both Tokyo Bay and the Arakawa River; the Tobu sludge plant is located where the Arakawa empties into Tokyo Bay. In March 2012, Tokyo began receiving contaminated debris from the earthquake-tsunami to be burned in incinerators located in densely populated areas and built only to handle regular household garbage. Some of the ash residue (I wasn't able to confirm how much) ends up as landfill in Tokyo Bay.[11] In the fall of 2011, Tokyo Governor Shintaro Ishihara embraced this plan as a way to patriotically share the suffering of victims of the triple disaster, and he finalized negotiations without bothering to consult Tokyo's 13.5 million residents. Certain aspects of Japan's post-3/11 "recovery plan" are the psychological pathology of certain species of politicians: Who needs engineering expertise in remediation when patriotism as defined by one man can become the basis for carrying out "decontamination" and "cleanup"?

Because I was not out on the street supporting anti-nuclear protests, I tried to amplify their work in other ways. Twice a year since spring 2012, I have required the students enrolled in my lecture course, History of American Literature, to watch a video featuring 10 women from Fukushima who participated in a 70-woman die-in on 7 June 2012 in front of the Prime Minister's Official Residence in Tokyo. It was a protest against his plan to restart the idled reactors at Ōi Nuclear Power Plant in Fukui prefecture. Before the start of the die-in, the women visited the Cabinet Office and met with officials to voice their concerns and submit a letter of requests to then PM Yoshihiko Noda. In the video, the women speak in turns, directly addressing their questions and statements to a prime minister who is not in the room. At the end, the woman who hands over their letter asks him: "Prime Minister Yoshihiko Noda, what are you looking at?

[11] From December 2011 to March 2012, radioactive debris from Onagawa, Miyagi was brought to Tokyo [17]. In May and June 2011, radioactive ash from incinerated sewer sludge, and sludge from water purification plants, was dumped in Tokyo Bay as landfill [18, 19]. On 3 November 2011, radioactive debris from Iwate was brought to Tokyo [20].

What are you looking at when you decide your policies?"[12] This is not a question for the prime minister only; it is a question that any nuclear expert whose expertise affected the siting and operation of Fukushima Daiichi NPP should be able to answer.

Sometimes I pair the video with a poem by American poet Lawson Fusao Inada, "To Get to Fresno" [23]. Inada was born and raised in Fresno, California, except for the three years from 1942 to 1945 that he spent in a concentration camp for Japanese Americans. But he left Fresno after college, and never returned. So the poem, "To Get to Fresno," is about how to remember and cherish a home/land that you have left permanently. Inada takes us on a trip around the world to enact the knowledge of different cultures and universal human being that Fresno gave him, and still gives him, whenever he chances to re-call this place in his heart. The poem leads us on a slow journey around the world, from Fresno to Fresnillo, Mexico, to the Ganges River, to Zimbabwe, to Moscow, to the tundra with its polar bears, and to many other places along the way, before returning to Oregon where Inada made his second home. I was hoping to get everyone to think about what it means to leave a home/land forever, and yet to remain there forever in heart and mind, and what it means to enter this phenomenon as a bystander. What does it mean for us in Tokyo, post-3/11, "to get to Fukushima"?

Sometimes I pair the video with a classic American picture book called *A Tree Is Nice*, written by Janice May Udry and illustrated by Marc Simont [24]. This is the first book I remember borrowing on my own from the public library in Kapahulu, Oahu, where I lived from age five through eight. My mother read it to me countless times, and later I read it for myself many more times. Trees are nice, we read and see, because they give us apples and a place to hang a swing, play pirate, or sit and think. They protect cows from the noonday sun, our homes from winter storms, and cats from dogs. We can rake up leaves in the fall and build a bonfire, or draw pictures in the sand with fallen branches. Trees make everything beautiful, we read and see, and if we plant a tree, we can watch it grow up year by year and point proudly to it, saying, "I planted that tree." As a child I loved this book with a fierceness not easily articulated in words even now. I was able to buy a copy of it when I was in my thirties, after I happened upon it by chance in Maruzen Bookstore in Tokyo, some time during the first years after my move to Japan in 1987 and well before Amazon.com could prevent me from experiencing such joyous serendipity.

I like to think that teaching Fukushima alongside *A Tree is Nice* or "To Get to Fresno" is an act of remediation of the sort I am capable of in my line of work,

[12] The video can be viewed [21]. Some of these women also appear in the documentary film *Women of Fukushima* (2012, Kugi Productions), by Paul Johannessen, Jeffrey Jousan and Ivan Kovac [22]. On June 8, the day after the die-in, PM Noda announced his intention to restart the two reactors at Ōi Nuclear Power Plant in Fukui prefecture. They were in fact restarted in July 2012 amidst widespread protest, but went offline again in September 2013 for a scheduled checkup. In May 2014, in a landmark decision, the Fukui District Court ruled in favor of a lawsuit representing Tokyo, Fukui, and twenty other prefectures to ban the restart of Ōi NPP.

and therefore have a duty to perform. I believe that teaching "Fukushima" has become a moral obligation for Japanese high school and university instructors across the board, so as to equip present and future generations of students with a clear understanding of nuclear energy—its historical development, socio-political contexts, and medical and environmental consequences—that will guide them when they take over the reins of Japanese society. In the first weeks and months after March 11, I could hardly bear to think about or look at trees, leaves, and dirt, wondering how much cesium had been absorbed into all the plants living and breathing between Tohoku and Tokyo and beyond. And although this acute sense of dread gradually faded, it was not because the cesium disappeared, but simply the lessening of a sense of crisis with the passing of time. The cesium (to mention just one contaminant) is still there, just centimeters below the surface of everyday life, its toxic half-life far from over.

23.5 Scientist Citizen: Cecile Pineda's Devil's Tango: How I Learned the Fukushima Step by Step

A "scientist citizen" is a layperson, an ordinary citizen, who acquires scientific literacy to exercise the right and duty of a citizen to work for the well being of all members of society.

The example I present here is Cecile Pineda, novelist and theatrical producer, whose anti-nuclear activism is based on extensive research into the history of nuclear reactors and radioactive waste.[13] *Devil's Tango* [25] was published on March 11, 2012. It is crammed with facts and figures about fallout from the Chernobyl and Fukushima nuclear accidents, about the process of building nuclear reactors from the mining of uranium to the storing of nuclear waste (including CO_2 emissions at every stage of this process), and about interconnectedness between the production of nuclear weapons and the production of nuclear energy, how depleted uranium from nuclear power plants has been recycled into weapons deployed in the Gulf War, the Iraq War, and the War on Terror in Afghanistan and elsewhere.

In lieu of providing a footnote for every single piece of information that she discovered or rediscovered to write this book, Pineda opts for a reader-friendly yet robust style of citation. Distributed throughout the 200 pages of *Devil's Tango* are roughly 80 parenthetical citations of books, articles, or websites, and 30 substantial quotations, of which many are from sources *not included* in the

[13] Four years before the publication of *Devil's Tango*, Pineda wrote and produced *Like Snow Melting in Water*, a play based on a true story about the Japanese village of Ogama, located on the Noto peninsula in Ishikawa prefecture. In 2006, Ogama's eight remaining elderly residents decided they had no choice but to move out, and sold their village to the Tashima Company, which planned to turn Ogama into a site for burying toxic waste [26].

eighty citations. Nineteen pages of reference material are provided at the end of the book. This bibliography includes a list of permissions and acknowledgments, and an appeal for donations to the Fukushima Information Center for Saving Children from Radiation/Citizens' Radioactivity Measuring Station, while also identifying:

- 30 organizations which provide information on nuclear energy (such as the Federation of American Scientists, Physicians for Social Responsibility, Union of Concerned Scientists)
- 17 websites concerning nuclear energy (such as Nuclear Resource and Information Service, The Fukushima Project (at SimplyInfo), The Energy Net, and Depleted Cranium (which seems basically pro-nuclear))
- 18 activist organizations
- 40 books
- 48 articles.

Yet no matter how extensive or reliable Pineda's investigation into nuclear accidents and radioactive waste, her scientist citizenship does not emerge through research alone. Acquisition and deployment of scientific literacy is motivated by a certain concept of citizenship, and Pineda sets up two sensory exercises, at the start and end of *Devil's Tango*, respectively, to indicate what this concept is. As we will see, scientist citizenship means protecting the lunchbox.

In March 2009, the spacecraft Kepler was launched from Cape Canaveral to search for other Earth-like planets where life as we know it might exist. Planets sighted by Kepler's telescope become archived as KOIs: Kepler Objects of Interest. In November 2013, based on data collected by Kepler, it was calculated that some 8.8 billion Earth-size planets occupy the "habitable zone" of the Milky Way galaxy [27]. Two years earlier, a team of astrophysicists at UC-Berkley had already begun looking at 86 KOIs in particular from among these potential 8.8 billion [28]. In the first chapter of *Devil's Tango*, called "Habitable Zones," Pineda asks us to think about these 86 planets in a particular way. First, we are asked to imagine each of them containing their own evolutionary history of life, an evolution from one-celled organisms into flowering plants and eventually into intelligent beings with the ability to use tools, compose music, and speak languages. Then we are asked to imagine what it would sound like if all the speech and music produced by inhabitants of these 86 planets were heard at the same time. But whether we want to attempt such a feat of imagination or not, Pineda points out that even the combined sounds of these 86 planets would only amount to 1/600,000,000th of the total sound produced by all neighboring galaxies, and therefore we cannot even begin to imagine how small the sound of our 86 planets would be in comparison to the total sound of the entire universe. Pineda opens *Devil's Tango* with this experiment in imagination to remind us that Earth comprises no more than a mere speck of life within the entire universe of space and time, and yet, our love for life on this particular planet is infinitely weightier and more enduring than a speck of space and time. We can supplement Pineda's exercise by trying to visualize any form of newborn existence, whether plant or

animal. As soon as we conjure up the most familiar images of flower buds or young leaves on a tree, or creatures hatching from their eggs, we are reminded that new life is utterly fragile and miraculous, and appeals to us for protection. This is the frame of mind—wonder and humility when witnessing the gift of life, and a sense of responsibility for the well being of all living things—that undergirds scientist citizenship.

At the end of *Devil's Tango*, in the chapter called "What the Light Was Like,"[14] Pineda presents us with another sensory exercise to complement the first one. This time we are asked to imagine a scene called up from the author's past—her memory of gazing at trees bathed in sunlight. Pineda recalls how she was able to comprehend the passage of time by watching how the light moved across a grove. The light embraced in turn each tree and every part of each tree as the earth turned on its axis, a movement normally imperceptible to us yet on that day made perceptible to her through attentiveness to the caressing passage of sunlight over trees.

Both of Pineda's sensory exercises are telling us to direct our gaze away from outer space toward this beautiful planet that we already inhabit, because without total *regard* for Earth, we risk destroying it beyond repair. Especially in the episode of remembering how sunlight moved across a grove, Pineda calls attention to the miracle of in/finite space and in/finite time that we are always capable of perceiving *in the here and now*. These sensory exercises re-inscribe a scientist's understanding of in/finite space and in/finite time in the language and point of view of a poet. For although space and time are foundational concepts in all fields of inquiry, philosophy, art, science, and social science have different ways of representing and thus comprehending space and time. The sensory images comprising Pineda's instructions for imagining the amplitude of 86 planets and thereby re-cognizing our commitment to planet Earth, and the sensory images comprising Pineda's instructions for seeing what she saw on that day of sunlight passing over trees, come from the discipline of poetry and exemplify her placement of the poet's toolbox in the service of the lunchbox. The most prominent example of Pineda's poetic language is of course the metaphor "devil's tango," which is used to illuminate the fact that nuclear history records a dance with death—Homo sapiens' apparent addiction to nuclear technology no matter how great its known record of devastation and irreversible damage.

Poetic language is not something for writers or literature scholars only, but is part and parcel of the language skills needed by a nuclear engineer—by any scientist or technician—to communicate specialized knowledge to laypersons, by virtue of the fact that poetic language is the primary language through which we comprehend and express the beauty of life and the gift of human being. To be a nuclear engineer without literacy in poetic language is to be like a computer with a voice, able to speak one's expert knowledge but devoid of any context of lived life

[14] Pineda [25], 202.

as Homo sapiens. The same holds true for laypersons. Without acquiring literacy in the data, vocabularies, and concepts that comprise, represent, and valorize the work of scientists, laypersons cannot properly understand, evaluate, or improve their physical environment. Responsible citizenship in a post-Fukushima Daiichi world requires that each layperson have literacy in science, and that every scientist or engineer have literacy in poetic language.

Dear nuclear engineers, I am trying to convey two points about *Devil's Tango*.

The first concerns Pineda's ethics of communication. She is an artist and writer who instructed herself to acquire a scientist's knowledge and vocabularies. Doing so did not require her to discard or demote her expert knowledge and skills as a poet. She operated on the assumption that the domain of science was not separate from or intrinsically superior to the domain of language arts, and that the two domains of knowledge must speak to each other or risk degradation and death to both. She used her expertise as a poet to communicate certain truths about science and technology that may not be readily perceived or admitted by scientists and engineers. For example, that certain forms of technological or scientific "progress" (nuclear energy is one of them) create toxic byproducts with life spans of millions of years; that some things whose origins are beyond human memory, like a grove of trees basking in sunlight for generations, are beautiful and necessary to our lives simply because they are *old-fashioned*, that is: fashioned in a space and time, and embodying a mode of life, that precede and exceed the conceptual categories and practices of modern science. This is not a rejection of science and technology per se, but an invitation to scientists and engineers to reconfirm whether their activities protect or degrade the lunchbox.

Hence my second point about *Devil's Tango*: I would like to suggest that it, and other books like it, become required reading for nuclear engineers. Understanding and appreciating what this book says does not depend on having a brain "wired" for poetry. Homo sapiens are, already, wired for both poetry and science to a remarkable degree. Rather, it's a question of attitude. If scientist citizenship begins by assuming that scientific literacy is necessary for ordinary life, citizen science cannot develop without a reciprocal assumption that the regard for life expressed in *Devil's Tango* is necessary to one's professional life as a nuclear engineer. When I first mentioned this book to Joonhong at some point during 2013, and before I had read it myself, I was surprised (and then not surprised, after all) to hear that he already owned a copy and had put it in the bag he carried to work everyday to make sure he got it read. Later he told me that while he could not agree with everything Pineda said, he respected her endeavor. The significance of this action (reading the book all the way through, making it a priority to do so) and response (partial disagreement anchored in respect for the other's point of view) cannot be overstated. It means that a nuclear engineer met an anti-nuclear activist halfway in an attempt to overcome entrenched oppositions between those working within the nuclear industry and those who seek to abolish nuclear energy altogether. If experts and laypersons both step forward to meet each other halfway, communication is possible and becomes productive.

23.6 Citizen Scientist: From Nuclear Engineers to GKS1350021

Dear Nuclear Engineers, will you take up the work of creating and operating an online, open-access, comprehensive, scrupulously updated, politically neutral,[15] and above all transparent and comprehensible "library" of nuclear science? Which would have all the features, pointed out earlier, of the Ex-SKF Blog, and if not Pineda's poetic skills, at least her ability to communicate scientific concepts and facts in words accessible to lay readers? For this to happen, you must think and act like citizen scientists. You must understand that your value to society is not determined by your expertise; rather, your worthiness as a nuclear expert is determined by your motivations and actions as a private citizen.

Because: every technological artifact, from microchip to nuclear reactor, is developed and deployed by human hands, and each one comes into being through a very long chain of human hands comprising the entire process from manufacture through installation to deployment to maintenance. In a so-called normal state of affairs, we pay scant attention to this chain of human hands despite knowing that each pair of hands is attached to an individual human being whose skills and work ethic affect our lives profoundly through their effect on the final quality of the technological artifact they have helped to produce. On the other hand, the abnormal state of affairs is when a crisis suddenly forces us to pay attention to the chain of human hands. In a crisis, such as the meltdowns at Fukushima Daiichi NPP, not only do we begin to see the human agency behind technology that normally goes unnoticed, we realize how just a few hands can make an enormous and even irreversible difference in the way the technology under crisis will henceforth affect our individual lives.

How communication enters the picture: Although it is true, and not just fashionable, to say that "telling the whole truth" can no longer be expected from mainstream media, one of the lessons learned by GKS1350021 is that turning to alternative sources of information via the internet or personal networks was not inherently more assuring or indisputably more reliable. Short of giving up on filtering information altogether, the same questions will appear before us again and again no matter what the form of communication: How are we to understand, assess, and integrate the information that is before us?

After March 11, before I had discovered Ex-SKF, I succumbed to ostrich syndrome for a while. As the task of collating and sifting information from different sources became too exhausting, I perversely fixed my attention solely on NHK,

[15] I know that 100 % political neutrality is impossible. What I am advocating is genuine self-monitoring to avoid, as much as possible, having one's analysis and reporting of information influenced by pressure groups, especially for-profit nuclear industries, Government, the military, and organizations who award grant money to underwrite scientific research. This is a tall order, but it can be done, and to do it imperfectly is better than to not try at all.

cynically disengaged yet at the same time desperate for a centralized source of reliable information and praying for a miraculous shift in Government's way of telling us what was happening. In retrospect, I can't help but feel that precisely because of widespread cooptation of mainstream media by industry and Government, now more than ever we must restore the concept and function of "mainstream media" as a centralized, trustworthy, open-access "library" of the most updated information comprehensibly written.[16] Given the enormous complexity of nuclear science, the truly global impact of nuclear waste, and the ease of disseminating misinformation or non-information through the internet just as easily as accurate and reliable information, it is more important than ever to have such a "library." And above all, the technical information accessed here must be communicated in such a way that every GKS1350021 can readily grasp it.

Here is a job for citizen scientists, for "nuclear engineers without borders." The task of creating and operating a nuclear science "library" cannot be entrusted to Government or the nuclear industry, nor should it be delegated to scientist citizens whose knowledge of nuclear science is, in the final analysis, a layperson's knowledge.

At present, information on nuclear energy comes to us primarily through staunchly pro-nuclear or staunchly anti-nuclear media, hindering meaningful dialogue between the two positions. A third party must enter the scene of communication because both pro- and anti-nuclear forces are not planning to go away anytime soon. For advocates of nuclear power, there is simply too much money to be made and the industry is also fatally entwined with supremely entrenched and secretive nuclear weapons production and deployment. Likewise, anti-nuclear advocates are also here to stay. They may seem infinitely disempowered by comparison, as non-profit organizations lacking influence in Government and industry, but they are just as tenacious in their goals and their numbers are growing.

Personally, I agree with the point of view that permitting the use of nuclear energy sanctions, no less than stockpiling or deploying nuclear weapons, the killing of human beings and the destruction of Earth (whether through the effect of nuclear energy's lethal byproducts on all forms of life and the physical environment, or through recycling depleted uranium into so-called conventional weapons). I am anti-nuclear, but I am also deeply pessimistic about whether the anti-nuclear agenda can ever succeed without dialogue (as impossible as that sounds) with pro-nuclear organizations and individuals, and whether

[16] Also: If this "library" is replicated in different languages (Chinese, French, Korean, Persian, Russian, for starters) working on the library might prove in itself to be a valuable mode of peaceful and truly cooperative diplomacy. For the task of translating between languages to insure that the libraries are identical in contents cannot be accomplished without genuine teamwork. Individuals have to spend many hours in dialogue to confirm that they understand each other and agree upon the translations. Further, creating multi-lingual libraries would raise levels of foreign-language fluency among nuclear engineers, which in turn means higher levels of cultural fluency across national borders that would feed back into the task of maintaining a centralized database with multi-lingual access and relentless commitment to comprehensibility and political neutrality.

the pro-nuclear agenda can ever change without dialogue (as impossible as that sounds) with anti-nuclear organizations and individuals.

Hence my desire to see the emergence of a third party, equipped with expert knowledge of things nuclear, committed to getting expert knowledge translated for comprehension by laypersons, and dedicated to transparency and political neutrality. Will nuclear engineers fill this role? There are sixteen student essays included in this volume, and although at first I had intended to read them prior to drafting my chapter, in the end I set them aside until I had clarified what I wanted to say. And now having read through these sixteen essays by future nuclear experts, I am moved to see how they take up, repeatedly and in different ways, the problems and practices examined and proposed in this chapter. I am filled with hope that the "library" I dream of in this chapter may soon come into being.

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